the AKWA letter

Vol. 9 No.2 The Official Publication of the Aquatic Exercise Association, Inc. Aug./Sept.

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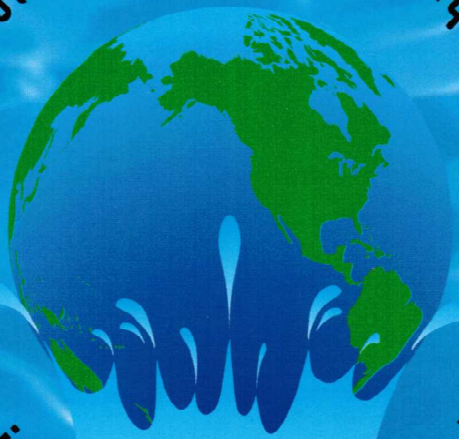

Conference Dates and Headquarters

Binghamton, New York
October 13-15, 1995
Holiday Inn Arena Conference Center

Charlotte, North Carolina
November 10-12, 1995
The Government House Hotel & Conference Center

First Part of a Three Part Series

Natatorium Air Quality Problems

by Alison Osinski, Ph.D.

PART 1

Natatorium air quality has always concerned aquatic professionals who spend their days working in an indoor pool environment. But recently, a few new problems have surfaced. Aquatic professionals are becoming aware that they may be working in an environment that is both stressful and potentially dangerous to their health.

In California, a group of public interest attorneys from the Pacific Justice Center and Mateel Environmental Justice Foundation have filed a complaint with the Department of Justice, naming pool and spa chemical manufacturers and several indoor pools and health clubs, claiming violations of Proposition 65*. The complaint alleges that use of chlorine to sanitize and oxidize pools is harmful to swimmers, and that the aquatic facilities named in the complaint failed to warn the public of the dangers of exposure to chloroform, a known carcinogen.

Proposition 65 is the California Safe Drinking Water and Toxic Enforcement Act of 1986. Its purpose is to identify carcinogens and reproductive toxins, and limit their release into the drinking water source. The federal Clean Water Act, and state regulations in several other states (Nevada Proposition 11, Georgia Safe Drinking Water Act, New Hampshire Groundwater Protection Act, Massachusetts House Bill 5109...) have similar provisions.

Proposition 65 requires that hazardous substances be identified, that a list be complied, and that the public be warned of the presence of these dangerous substances. Signs must be posted and warning labels affixed to hazardous products to warn the public of the risks of possible exposure to chemicals. The Proposition (§25249.6) further requires that "No person in the course of doing business shall knowingly and intentionally expose any individual to a chemical known to the state to cause cancer or reproductive toxicity without first giving clear and reasonable warning to such individual."

The California attorney general's office may file charges for violations of provisions of the Proposition. The EPA may apply penalties to offenders for damage to the environment or for clean-up procedures if hazardous materials are released into the environment. And, citizens or groups representing the citizens of the state, may also initiate lawsuits against offenders and collect a por-

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Natatorium Air Quality Problems

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tion of the fines.

Benoit Levesque and a half dozen colleagues recently published the results of their study entitled "Evaluation of dermal and respiratory chloroform exposure in humans" in the December 1994 issue of Environmental Health Perspectives. Results of the chloroform exposure study have been widely disseminated and re-printed by pool industry and legal journals and by the popular press, and may have been the impetus for the Proposition 65 complaint filed in California.

Data was collected by Levesque's experimenters over a period of one week in April 1993 at an indoor 25 meter by 10 meter pool in Quebec, Canada. The natatorium had a negative pressure atmosphere with a constant ventilation rate. Chloroform levels in the water and air were measured every 10 minutes.

Subjects were eleven male SCUBA divers whose ages ranged from 19 to 38 years. Subjects were given VO_2 max treadmill tests prior to the collection of data. During the study, subjects wore heart rate monitors to provide feedback, and exercised at either 45% or 65% of maximum capacity on different test days. The test period lasted for 55 minutes on each of the seven consecutive days and consisted of three 15-minute long periods of swimming which were separated by 5 minute rest periods. On one of the test days, subjects wore SCUBA gear while swimming in order to isolate dermal exposure from the chloroform exposure resulting from inhalation. Alveolar air samples were collected before, 35 minutes into the exercise period, and immediately after exercise by having subjects exhale through a tube into a sample container.

Chloroform is the chlorination by-product formed when chlorine in pool water reacts with organic pollutants. Chloroform ($CHCl_3$) is the most common and abundant of the tri-halomethanes (THMs). The amount of tri-halomethanes present in pool water is dependent on the chlorine dosage or bromide ion concentration and the concentration of organic precursors. Properly sized, designed and installed ozone generation systems would eliminate the precursors of THM formation. The amount of chloroform in the air is dependent on the number of swimmers, water turbulence, water and air temperature, the ventilation rate and the distance from the water. Chloroform concentrations are greatest at the water surface. Water fitness instructors and participants who exercise intensely while breathing the air directly above the surface of the pool are at great risk of exposure.

Exposure level is dependent on the water volume to bather load ratio, the concentration of chloroform in the water and air, the amount of time spent in the pool and the intensity of exercise while in the pool. In addition to water fitness instructors and participants, long distance swimmers, frequent swimmers, lifeguards, swim instructors, coaches and pool maintenance personnel are all members of potentially high exposure groups.

Results of the study showed that approximately 24% of the "body burden" of chloroform exposure resulted from dermal absorption (through the skin) while swimming. The proportion of body burden due to inhalation of ambient air directly over the pool averaged 76% at 35 minutes, and as high as 78% at 55 minutes or the conclusion of the exercise period. Some chloroform was present in subjects' lungs prior to exercise as a result of air contamination in the locker rooms. The concentration of chloroform increased, depending on the exercise intensity and amount of chloroform in the water and air above the pool, from an average 52.6 parts per billion (ppb) prior to swimming to a low of 100 ppb to as much as 1,093 ppb at the completion of the daily swim.

Experimenters estimated swimmers received a chloroform dose of 65 µg/kg/day from a 1 hour swim at breathing rate of $0.03m^3$/minute. This was a 141 times greater dose from swimming than from taking a ten minute shower, or 93 times greater dose than from drinking tap water.

* (Pacific Justice Center and CA Attorney General's office have decided not to proceed with formal charges at this time.)

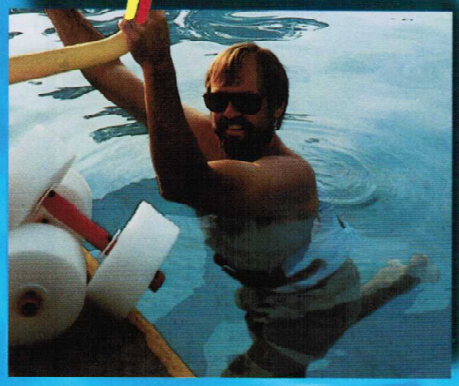
Listings of Organizations dealing with air quality and references available upon requests.

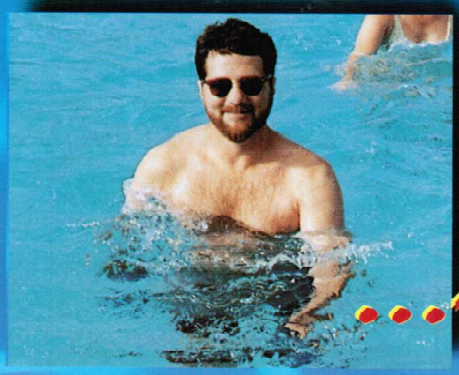
This article appears as Part One of a Three Part Series. Alison Osinski's full biography will be printed in the December issue.

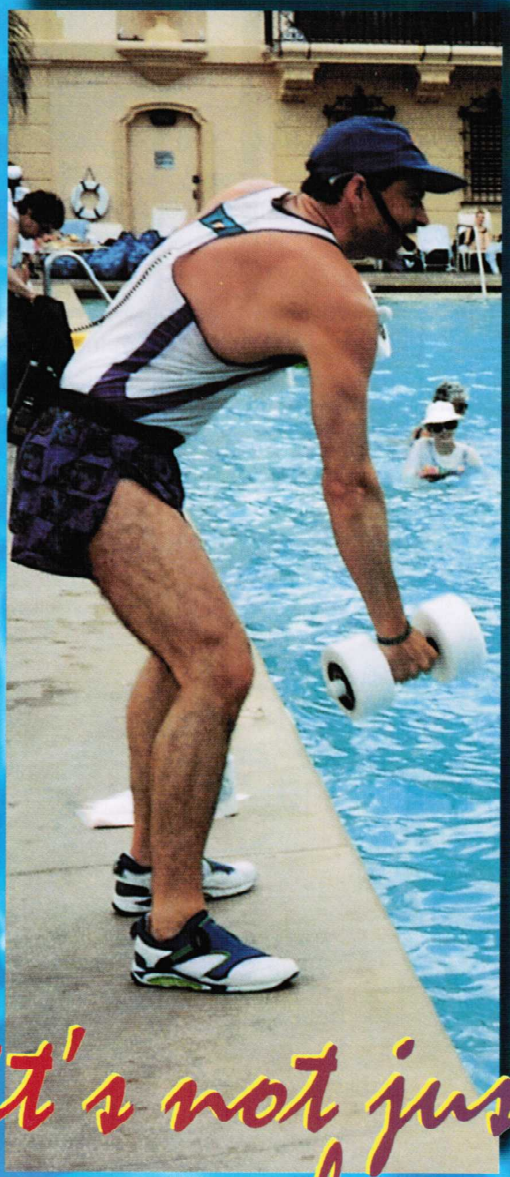
the AKWA letter

VOL. 9 No.3 The Official Publication of the Aquatic Exercise Association, Inc. Oct./Nov.

Aquatic Exercise...







ALSO INSIDE:

...it's not just for women!

Second Part of a Three Part Series

Natatorium Air Quality Problems

by Alison Osinski, Ph.D.

Indoor work environments should be healthy and comfortable. The air should be free of contaminants and odors. Temperature, relative humidity, noise and illumination levels should all be satisfactory and beneficial to a productive, stress free work environment.

Unfortunately, many indoor pools are poorly designed, maintained and operated. As a result, disproportionate numbers of sick building syndrome, building related illness, multiple chemical sensitivity, and hypersensitivity disease problems are being reported.

"Sick building syndrome" is an indoor air quality problem in which the source of the illness cannot be positively identified, and symptoms of the illness last two or more weeks. Symptoms of sick building syndrome disappear or subside when the person leaves the building for a period of time.

"Building related illness" is similar to sick building syndrome, but the cause of the symptoms is known, and can be traced to a specific source. A distinguishable set of symptoms can be identified.

"Multiple chemical sensitivity" (MCS) is an illness that occurs to some individuals who become sensitive to a number of chemicals at low concentrations. There is some debate over whether MCS is an actual physical illness or symptoms are actually psychosomatic.

Hypersensitivity diseases such as asthma or rhinitis occur as a result of an allergic response to animal antigens. Hypersensitivity pneumonitis (HP) is a rare but serious disease which causes progressive lung damage if an individual is continually exposed. HP is diagnosed by lung biopsy using a bronchoscope. One public pool complex near Denver, Colorado reported seventeen pool employees who developed HP as a result of exposure to, and inhalation of, high levels of endotoxins. Endotoxins are dead bacteria cell walls. Pathogens (disease causing organisms) were destroyed by the chlorine present in the pool water, but the facility had a problem with incomplete oxidation of pool water contaminants, poor removal of floating debris from the water surface due to a poorly designed perimeter overflow system, and inadequate ventilation of contaminants that became aerosolized when the numerous moving water features in the natatorium were in operation.

How big is the problem? According to Hennessey (1992), the U.S. EPA and the World Health Organization estimate that 20% of buildings in the U.S. have serious indoor air quality (IAQ) problems and 40% have somewhat serious problems. Only 40% have no serious IAQ problems. Unfortunately IAQ problems are getting worse. Energy efficient design, improved building insulation, poor ventilation, less fresh air being brought into buildings and windows that don't open, greater use of chemicals, cleaning agents and building materials which emit chemicals are all contributing to the problem. Facility users add to the problem by smoking, and by wearing cosmetics, fragrances, and scented personal care products. Contaminants and sources of contamination include chemicals, dusts, gasses, vapors, aerosols, fumes, mists, smoke, moisture, maintenance and cleaning supplies, pesticides, and airborne micro biological hazards comprising bacteria, fungi (yeasts and molds), viruses, and protozoa.

Building materials used in the construction of the natatorium are often a source of contaminants. Volatile organic compounds (VOCs) released from building materials such as formaldehyde in plywood and particle board, adhesives, sealants, coatings, carpet and flooring materials, wall coverings, insulation, acoustical tile, and furnishings can all add pollutants that may become irritants.

HVAC (heating, ventilation, air conditioning) units themselves are often a source of contamination. Bioaerosols (airborne pathogenic organisms), HVAC construction and insulating materials, dirt and dirty filters, moisture collection within the systems, incomplete combustion of carbon monoxide, intake of contaminated or polluted outside air, and lack of preventative maintenance, service or repairs can lead to problems. HVAC systems are often improperly balanced in natatoriums. Since pollutants travel from positive to negative pressure areas, the natatorium should have positive pressure.

Another contributing factor to IAQ problems in pools, is changing occupant loads or the way in which the space is used without changing the ventilation equipment. Natatorium air handling systems designed to deal with the demands placed on the natatorium by a few lap swimmers or a single instructional swim class are often overwhelmed by multiple, mixed-use aquatic classes occurring simultaneously, large groups of spectators, or water fitness programs drawing hundreds of participants a day.

Major causes of sick building syndrome in indoor pools include: airborne pollutants present in the environment as a result of chemical dissipation and incomplete oxidation of organic contaminants in the pool water, inadequate ventilation, and poor air flow patterns in the natatorium.

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HYDRO-FIT Conducts Field Test at IAFC

Thirty-eight healthy adults (ages 24-59) participated in a field test of the HYDRO-FIT WAVE Run™ program at IAFC '95 in Coral Gables, Florida. The thirty-eight participants attended a pre-conference session conducted by the Company. The purpose of the test was to examine heart rate response during the WAVE Run program using the POLAR Vantage XL Heart Rate Monitor. "Palpating in the water has been a controversial issue over the last couple of years. On the other hand, accurate heart rate monitoring has not been used extensively in water exercise from a vertical position", said Company president, Craig Stuart.

Measurements were collected over a 40-minute period in which subjects participated in a deep water exercise class consisting of an 8 minute warm-up, a 22 minute aerobic conditioning segment, and a 10 minute cool down. Preliminary results indicate that only 2 of the 38 subjects were unable to attain their (THR) Target Heart Rate. (Two subjects were not included in the results because of measurement system failure.) Among the 34 subjects who achieved their THR, the average time each subject spent exercising in their THR zone was 46%. "I am very encouraged by the results," said Craig. "Our goal was to test the effectiveness of the exercise protocol to elicit and sustain a prescribed cardiovascular response, and we did that."

The field test administered at IAFC is the first phase of a pilot study being conducted by the Company. The study seeks to accurately measure cardiovascular response for the purpose of further refining the WAVE Run program.

Natatorium Air Quality Problems

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Drowsiness, fatigue, frequent headaches, itching eyes, irritability, dry skin, skin rashes, chills, nausea and gastrointestinal tract symptoms, sinus congestion, sore throats, forgetfulness, reduced productivity, viral and bacterial infections are all symptoms of sick building syndrome frequently reported by individuals who work or spend extended amounts of time in some natatoriums.

Health risk factors can be identified by evaluating chemical properties such as the toxicity, solubility, vapor pressure; physical properties -- size and shape of contaminants; the dose concentration, exposure route and length of exposure time; and environmental factors like the temperature, humidity, light, pressure, and noise present in the area. A person's age, sex, genetic make-up, diet, health, and whether or not he or she uses certain drugs or alcohol, or smokes can also affect susceptibility. Some individuals are susceptible below threshold limits because they have a reduced defense mechanism against toxic substances from previous exposures or a pre-existing condition that may be aggravated by low level exposure. Populations at greatest risk to poor IAQ include smokers, the elderly, newborns or very young children, persons with hay fever, bronchitis, asthma or emphysema, heart patients, and persons with compromised immune systems.

The costs associated with ignoring IAQ problems include decreased productivity, high absentee rates, and underused or unusable facilities. There are also legal implications and costs associated with litigation. In the first known IAQ case, Call v. Prudential, the court ruled that a building is a product, and anyone associated with the leasing, construction or design of the building could be held liable for injuries to a plaintiff. In another case, Buckley v. Kruger-Benson-Ziemer, the plaintiff, a computer programmer, successfully brought suit against nine named and 280 unnamed defendants including the building's architects, contractors, and HVAC engineers; and the manufacturers, retailers and installers of the air conditioning equipment, carpeting, floor tiles, adhesives, and chemicals used at the facility. The case was settled in 1992 after five years of very expensive and time consuming litigation.

Listings of Organizations dealing with air quality and References available upon requests.

This article appears as Part Two of a Three Part Series. Part One appeared in the August/September issue. Alison Osinski's full biography will be printed in the December issue.

F.Y.I.

AQUATIC EXERCISE ASSOCIATION MEMBERSHIP DUES:
Effective January 1, 1996, AEA will increase its membership dues as follows:

Professional $48 per year
Professional Plus $120 per year
Business $180 per year

These fees are based in the United States only. Please call AEA for International prices.

ATTENTION: CEC Providers
AEA begins its new continuing education provider term January 1, 1996. This term expires December 31, 1997. Provider lists will be available to all AEA certified instructors beginning February 15, 1996. If you would like a copy of the new list, please send a written request to our Corporate Office after than January, 1996.

CEC Petition-Non approved provider courses
Beginning January 1, 1996, all certified instructors that attend courses not pre-approved by AEA will have to pay a petition fee of $10.00. Each CEC Petition Application is valid for up to four non-approved courses. All courses MUST be submitted together. The $10 fee applies per petition submitted. If you need a copy of the application, please contact our Corporate Office.

The Aquatic Exercise Association is pleased to announce a **GENERAL LIABILITY INSURANCE** program available to AEA certified instructors. A master policy has been issued to AEA by The International Special Events and Recreation Association. AEA certified instructors will be added to this policy. ISERA is a registered Risk Purchasing Group operating under Federal Law 97.45 since 1986. For more information or to receive a simple questionnaire please contact ISERA directly at 1-800-521-1709 Linda Sundquist or 1-800-262-3719 Rick Bjornson. You may also contact AEA at 1-941-486-8600.

the AKWA letter

VOL. 9 No.4 The Official Publication of the Aquatic Exercise Association, Inc. Dec./Jan.

Seasons Greetings

Featuring:

Liability Insurance Available Through AEA...PG 7

Third Part of a Three Part Series

Natatorium Air Quality Problems

by Alison Osinski, Ph.D.

Control measures can reduce the level of exposure to contaminants in the environment. Some contaminants can be contained by installing barriers. For instance health clubs should not use the same space to house both the pool and aerobic areas, nor should those areas share the same air. Administrative controls can be instituted. Smoking policies can be enforced. Time restriction on the number of hours spent working in the natatorium can be implemented. The HVAC system can be upgraded to better control temperature and humidity, redistribute the air flow, and increase the ventilation and percentage of fresh air brought into the natatorium. Contaminants can be removed from the building and replaced with less hazardous substances.

Enforce compliance with OSHA Permissible Exposure Limits (PELs), including 8-hour time weighted average (TWA) concentrations, ceiling limits (CL) — the maximum concentration for exposure at any time during an 8-hour work shift, and action levels (AL). Remember that exposure can exceed the AL for a specific amount of time, but the employer must prevent the contaminant concentration from reaching the PEL. Similarly ACGIH limits should be followed for regulated chemicals. The American Conference of Governmental Industrial Hygienists, a trade organization for occupational and environmental health professionals, establishes and annually updates recommended exposure standards, including concentration of airborne substances to which most workers can be exposed daily without harming their health called Threshold Limit Values (TLV). Threshold Limit Values include TLV - TWA (time weighted average for an 8 hour workday in a 40 hour work week), TLV - STEL (maximum short term exposure limit), and TLV - C (concentration ceiling that should not be exceeded).

Finding a solution to an air quality problem first requires that the problem be recognized and admitted. Gather information by making observations, reviewing complaints that have been filed, interviewing staff members, and surveying participants. Review the Material Safety Data Sheets (MSDS) for all substances used in the natatorium. Next, evaluate and measure the extent of the problem.

Natatorium air must be sampled so that it can be analyzed quantitatively and qualitatively. Air samples should be gathered from the area six inches above the pool water surface, and from the personal breathing zone of employees who work in the natatorium. Air contaminants can be sampled using volumetric pumps, direct reading electronic instruments like dosimeters, wall mounted air monitoring devices, or by having pool employees wear personal dosimeters, detection tubes or chemical monitoring badges. Collection of biological specimens (blood, tissue, urine, exhaled air) may also be necessary.

A variety of analytical tools can be used for evaluating the natatorium environment. Air motion is evaluated using foggers and smoke tubes. Air velocity is measured in feet per minute with a mechanical air velocity meter or anemometer. Air flow is measured in cubic feet per minute using an air flow meter, or with a balancing hood and adapter. Hygrometers, thermometers, light meters, and sound level meters are used to gauge relative humidity, temperature, illumination and noise levels, respectively.

If results of tests show overexposure in excess of exposure limits, the employer must take immediate steps to reduce the level of contaminants. In the meantime, adjustments should be made in work hours, or the way in which work is performed.

An often ignored component of natatorium air quality is relative humidity. Relative humidity is a reflection of the percentage of moisture in the air compared to the amount of moisture the air could hold if it was saturated at the same temperature. ASHRAE (American Society for Heating, Refrigeration and Air Conditioning Engineers) Standard 55-1992 recommends that relative humidity of all occupied spaces be maintained between 30 and 60%. Ideally, natatorium relative humidity levels should remain low, between 50% and 60% during the summer months, and between 30% and 50% in the winter or when outside temperatures dip below 45° F. Maintaining excessively low humidity in a natatorium can cause dry skin, chapped lips, nose bleeding, and sore throats. High humidity can cause corrosion problems, and major damage to interior natatorium surfaces that have a tendency to escalate rapidly. Humid conditions are also favorable for growth of bacteria, yeasts and molds.

Probably the most serious result of long term maintenance of high relative humidity levels and inadequate ventilation of chemically laden air in the pool environment, is pool ceiling collapses. Moisture infiltrates concrete and other building materials and weakens them. Pitting, stress corrosion, and cracking occurs. The cumulative effect of years of exposure of coated stainless or galvanized steel hangars, cement, ceiling panels, conduit, hanging light fixtures, steel beams, and reinforcing bar to chlorine vapors is transcrystalline tension-crack corrosion. When ceiling supports can't withstand the tensile load, the whole ceiling gives way and falls into the pool. Look for signs of possible ceiling damage such as water dripping or rain falling onto the pool deck from the ceiling, water logged or sagging suspended ceiling panels, evident corrosion and staining of beams and metal objects in the pool area, rotted wood, moisture condensation on windows, skylights or walls; and chlorine dusting stains left behind by evaporated water on the ceiling and natatorium walls. If any signs of deterioration are present, hire a registered professional engineer to inspect for structural integrity of the ceiling over the pool. Annual inspection of commercial pool ceilings is required by the state of Massachusetts.

Ambient air temperature in a natatorium should be comfortable, and appropriate for activities being conducted, level of activity, and desires of the primary or priority user group. Air temperature should be maintained two to seven degrees higher than pool water temperature. ASHRAE Standard 55-1992 "Thermal Environmental Conditions for Human Occupancy" requires that thermal environmental conditions (temperature and relative humidity) be acceptable to at least 80% of the occupants.

Air temperature should not fluctuate, but should be constant. When not in use, an indoor pool should be covered. Insulating pool covers prevent dirt and debris from entering pool, reduce maintenance time, heating costs, and chemical dissipation; and conserve make-up water. More importantly though, covering pools reduces the need to ventilate indoor pools and pre heat or pre cool outside air, helps prevent rusting and deterioration of structural components, and improves indoor air quality.

The majority of indoor pools are not properly ventilated. At least

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Natatorium Air Quality Problems

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six, and preferably eight complete air exchanges per hour should occur in a natatorium. This is measured by dividing the quantity of outdoor air brought in by the building volume.

Fresh air should be introduced at a rate of 0.5 cfm (cubic feet per minute) per square foot of pool and deck area, plus another 15 to 25 cfm for each anticipated bather or spectator, depending on the activity level of pool users. Compliance with ASHRAE Standard 62-1989 "Ventilation for Acceptable Indoor Air Quality" should be the minimum requirement. The ASHRAE ventilation rate procedure requires that ventilation rates be based on space function, at a minimum rate of 15 cfm per person, and that carbon dioxide levels be maintained below 0.1 % or 1,000 ppm.

Regardless of the adequacy of the ventilation rate, the air distribution system in a natatorium must be properly designed. Air should always be introduced into the pool area from low to high. Return air grilles should be installed near deck level. A very common natatorium design error involves installing all the ductwork at ceiling level. Introducing warm supply air through diffusers installed in the ceiling 15 to 30 feet above the pool will almost guarantee bather discomfort. Since warm air rises, there is almost no chance that warm air supplied at ceiling level will ever reach the deck or pool. Unless supplied at a very high velocity, ceiling supplied warm air will just cling to the ceiling and be vented out of the natatorium. Reduced bather comfort due to drafts and temperature gradients; and serious water quality problems resulting from inability to completely oxidize organic contaminants or reach chlorine breakpoint due to lack of oxygen over the pool can be traced to this problem

Sidebar

Air Quality Standards have been developed and are available from the following organizations:

- Occupational Safety and Health Administration
  "Permissible Exposure Limits"
- U. S. Environmental Protection Agency
  "National Ambient Air Quality Standards"
- American Conference of Governmental Industrial Hygienists
  "Threshold Limit Values"
- American Society of Heating, Refrigeration and Air Conditioning Engineers
  "Standard 62-1989 - Ventilation for Acceptable Indoor Air Quality"
  "Standard 55-1992 - Thermal Environmental Conditions for Human Occupancy"
- American Industrial Hygiene Association
  "Workplace Environmental Exposure Levels
- National Institute for Occupational Safety and Health
  "Recommended Exposure Levels
- World Health Organization
  "Air Quality Guidelines for Europe"
- Canada Environmental Health Directorate
  "Exposure Guidelines for Indoor Air Quality"

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This article appears as Part Three of a Three Part Series. Part One appeared in the August/September 1995 issue. Part Two appeared in the October/November issue 1995.

Alison Osinski is the principal-owner of Aquatic Consulting Services, located in San Diego, California, specializing in aquatic risk management, aquatic program development, boating safety, water quality analysis, staff training, and aquatic facility design, maintenance and operation.

Dr. Osinski is an author with over 70 publications to her credit, workshop coordinator and frequent speaker at national aquatic conferences. She has served as an expert witness on over 75 aquatic cases involving personal injury or pool construction defects. She is actively involved, and currently serves as an officer or advisory board member, with several national and regional aquatic organizations.

Dr. Osinski also runs the "Swimming Pool Hotline" (900-446-6075, ext 82) and provides phone information directly to aquatic professionals and pool owners and operators.

SPECIAL UPDATE:

As of October 1995, the Pacific Justice Center and CA Attorney General's Office have renewed litigation mentioned in Part I. Although fewer defendants have been named, chlorine as well as bromine by-products are now listed.